FEEDS AND FEEDING
MANUAL

SAVAGE AND MORRISON

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FEEDS AND FEEDING MANUAL

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INTRODUCTION

"Feeds and Feeding Manual" first published in 1913, has apparently met a need in instruction in animal husbandry, due to the fact that it helped students to master important facts in live stock feeding by providing a convenient means of working out practical problems and rations. The manual was revised in 1915 and has since been twice reprinted. This edition has again been thoroly revised and certain improvements have been incorporated.

This manual has been prepared so that students in a course in *Feeds and Feeding* may make a systematic study of feeds and rations and may preserve the result of such study in convenient permanent form. The manual is designed especially for use with *Feeds and Feeding*, by W. A. Henry and F. B. Morrison, or with *Feeds and Feeding, Abridged*, by the same authors. The exercises have been made practical, based as far as possible on actual experience. The computations required have been chosen to teach something besides mere arithmetic. In the exercises which are here given the student will be required to make over and over again those computations which he will be forced to make in actual practice. He will thus become familiar with the methods of computing rations and with as many as possible of the feeds in common use in the United States.

The objects in mind in teaching an elementary course in *Feeds and Feeding*, as the authors see them, are three: (1) To teach the fundamental principles underlying the practice in feeding farm animals. (2) To teach as much as possible concerning the source, composition, and usefulness of the feeds commonly used in this country. (3) To teach the practice of feeding itself, so far as practice can be taught in the class room with occasional visits to the barns.

The teaching of the principles of nutrition which underlie the practice of feeding has been left to lecture and text-book. In this manual exercises have been outlined which will guide the student in his study of 50 common feeds. In addition, problems have been suggested covering rations for dairy and beef cattle, horses, sheep, and swine. In these problems the comparative usefulness of the common feeding standards is brought out, and the fact is impressed on the student that in order to formulate a ration intelligently, the nature, composition, usefulness and relative cost of a large variety of feeds must be known. A method of computing the relative value of the several feeds is clearly illustrated in the computation of the problems.

There have purposely been included in the manual more exercises and problems than can be worked out by most classes in the amount of time available. This has been done in order that each instructor may select the exercises and problems which are especially important in his own section. Additional blank pages are provided at the rear so that the instructor may assign special problems of local interest, if desired.

The authors wish to acknowledge the help of Professor W. A. Henry of the University of Wisconsin and of Professor H. H. Wing and Mr. T. A. Baker of Cornell University in the preparation of this manual.

ELMER S. SAVAGE,
F. B. MORRISON.

EXERCISE 1

DIGESTION COEFFICIENTS AND DIGESTIBLE NUTRIENTS

In order to feed livestock most economically and efficiently, one must understand thoroly the chemical composition of the available feeds, the extent to which livestock can utilize each feed, and the actual feeding value of these feeds for the various classes of stock. Then, after finding the cost of the different feeds in any section of the country, an economical and efficient ration may readily be worked out, to suit the conditions in that particular district. Keeping in mind that the chief object of a course in *Feeds and Feeding* is to enable the student to feed farm animals more cheaply and efficiently, the exercises in this manual have been so arranged that first the composition, feeding value, and economy of different feeds are fully considered, and then the knowledge so gained is applied in working out practical rations for the different classes of animals.

The relative value of feeds depends not on their total chemical composition, but on the amount of nutrients which each feed actually furnishes. The most simple, and likewise the most common, method of measuring the usefulness of feeds is to determine the digestible nutrients in 100 lbs. of each feed. The method of finding the *coefficients of digestibility* or *digestion coefficients* of various feeds and of computing the *digestible nutrients* is fully explained in Part I of Chapter III of *Feeds and Feeding* or of *Feeds and Feeding, Abridged.*

After studying thoroly this portion of whichever book is used as the text, work out the following problem. Put the summaries of your computations on page 8 in neat, logical form.

Problem.—During a 10-day digestion trial a cow consumed 96 lbs. of alfalfa hay, the average composition of which was 8.1 per ct. water, 8.8 per ct. ash, 14.6 per ct. crude protein, 28.9 per ct. fiber, 37.4 per ct. nitrogen-free extract, and 2.1 per ct. fat. During this time the cow voided in her feces or solid excrement 4.9 lbs. ash, 4.2 lbs. of crude protein, 15.2 lbs. of crude fiber, 1.16 lbs. of fat, and 35.7 lbs. of total dry matter. Find the coefficients of digestibility of the dry matter, crude protein, fiber, nitrogen-free extract, and fat.

Also compute the digestibility of the ash. This is not commonly given in tables of digestion coefficients, but can be computed from the data given in the problem.

FEED STUDIES

To aid in fixing in the mind the most important facts concerning the more common feeds, feed study blanks are provided for the systematic study of 50 feeds. Before filling out the feed study blanks for the two feeds given on the next page, read the following directions carefully, and be sure you understand them.

Source and definition.—Under "Source and definition" state briefly what the feed is.

Total composition.—Copy the total composition from Appendix Table I of the text book.

Coefficients of digestibility.—Copy the coefficients of digestibility from Appendix Table II of the text.

Digestible nutrients.—Compute the digestible nutrients for the first four feeds studied, using the total composition and the coefficients of digestibility you have already copied.

Enter in the proper spaces in the table the pounds of digestible fiber and of digestible nitrogen-free extract separately, and then add these numbers together to find the pounds of digestible carbohydrates. Enter this also in the table.

The coefficients of digestibility for the ash in feeds are not given in Appendix Table II. The digestible ash and the coefficient of digestibility for the ash can, however, be found as follows: First compute the digestible dry matter and the digestible nutrients, except the ash. Then subtract from the digestible dry matter the sum of the digestible protein, carbohydrates, and fat. (Do not multiply the fat by 2.25.) This will give the digestible ash. From this you can find the coefficient of digestibility for the ash.

The digestible nutrients should be computed to tenths of pounds. If in the computations the figure in hundredth's place is 5 or more, add 1 to the tenth's place; if less than 5, disregard it. Use this rule in general in dropping decimal places.

Total digestible nutrients.—Compute the total digestible nutrients in 100 lbs. and in 2,000 lbs. of each of the first four feeds studied, and enter the figures in the proper place on the feed study blank. The total digestible nutrients in any amount of a given feed equal the sum of the digestible crude protein, the digestible carbohydrates, and the digestible fat multiplied by 2.25. The formula for "total digestible nutrients," following the above definition, is: Total dig. nutr. = Dig. protein + dig. carbohydrates + (dig. fat × 2.25).

Compute the total digestible nutrients in 2,000 lbs. to the nearest whole number, using the general rule just mentioned for dropping decimals.

Nutritive ratio.—Compute the nutritive ratio of the above feeds according to the definition and formula given in the text. Compute the second term of the ratio to one decimal place.

Price per ton.—Enter on page 7 and on the feed study blanks the local price of each feed. These prices will be furnished by the instructor, or may be ascertained from market reports, feed dealers, etc.

Weight of concentrates.—In the case of concentrates the bulkiness of the feed, as shown by the weight per quart, is important. Hence for concentrates copy the weight of 1 quart from Appendix Table VII of *Feeds and Feeding* or from Appendix Table IX of *Feeds and Feeding, Abridged.* If possible determine the weights by actually weighing them.

Cost of 1 lb. total digestible nutrients.—Perhaps the most convenient way of determining which feeds are the most economical under the conditions in a particular district at any time is to compute the cost at which each of the available feeds furnishes 1 lb. of total digestible nutrients. As is pointed out further in Exercise 6 and in Chapter VIII of the text, this is a measure of the economy with which the various feeds furnish fuel or energy. The "Cost of 1 lb. total digestible nutrients" should therefore be worked out for each feed and entered on the feed study blank. Compute this cost to hundredths of a cent, using the price per ton given for each feed.

Cost per lb. digestible crude protein.—Protein-rich feeds are commonly higher in price than those rich in carbohydrates in most districts of the country. In balancing rations economically, it is therefore necessary to find out which feeds furnish digestible crude protein most cheaply. Therefore, compute for each feed, and enter in the feed study blank, the "Cost per lb. digestible crude protein."

Palatability, usefulness and limitations.—Under "Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine," state briefly, but as definitely as possible, the value of the particular feed for *each* class of stock. Before attempting to do this, consult the index of your text, and read carefully the paragraphs in the text on the value of the feed for each class of stock. Do not rely on your general knowledge of the feed, but be specific.

Timothy hay, $............ per ton. Use the figures in Appendix Table I, given under "Timothy, all analyses," and the figures in Appendix Table II which are the "Average of all trials." The value of timothy hay for horses, dairy cattle, beef cattle, and sheep is fully discussed in the text. It is not useful for swine. Would you grow much timothy on a livestock farm in your section?

Red clover hay, $............ per ton. Use the figures in Appendix Table I, given under "Clover, red, all analyses," and the "Average of all trials" in Appendix Table II. Red clover exceeds any other legume in acreage in the United States. Discuss its value thoroly.

FEED STUDY BLANK

Name of feed..

Source and definition...

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COMPOSITION OF 100 POUNDS OF FEED

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	....	....	....	....	....	....	
Coefficient of digestibility..............	....	....	....	....	....	....	
Digestible..........	....	....	....	....	....	....	....
				....			

Total dig. nutr. in 2,000 lbs................ Nutritive ratio.................

Price per ton $.................. Weight of 1 quart....................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein....................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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FEED STUDY BLANK

Name of feed ....

Source and definition ....

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COMPOSITION OF 100 POUNDS OF FEED

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	......	......	......	......	......	......	
Coefficient of digestibility	......	......	......	......	......	......	
Digestible	......	......	......	......	......	......	......
				....			

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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EXERCISE 2

RATIONS AND CLASSIFICATIONS OF FEEDS

Feed studies.—Make complete studies of the following feeds, using the feed study blanks on pages 17 to 23.

Alfalfa hay, $............ per ton. Use the figures in Appendix Table I given under "Alfalfa, all analyses." If using *Feeds and Feeding* as the text, take the coefficients of digestibility for "Average of all trials." In *Feeds and Feeding, Abridged* these coefficients of digestibility are the only ones given for alfalfa hay. Why has alfalfa increased so rapidly in acreage in this country?

Corn silage, well matured, $............ per ton. Use the figures in Appendix Table I under "Corn Silage, well-matured, recent analyses," and the coefficients of digestibility for "Corn Silage, dent, well-matured." In your notes show why corn silage has revolutionized stock feeding in recent years in most districts of the United States.

Dent corn, $............ per ton. Use the figures from Appendix Table I for "Dent corn." These are for well-dried corn. Take the figures from Appendix Table II for "Corn meal." Study thoroly the paragraphs in Part III of the text discussing the value of corn for the various classes of stock and make your notes complete.

Rations.—Be sure you know the definitions in the text for *ration* and *balanced ration.* Remember that both apply to the feed supplied to *one* animal for *24 hours.*

Problem.—The average cow in a farmer's herd weighs 1,000 lbs. She yields daily 25 lbs. of milk testing 4.0 per ct. in butter fat. He feeds her the following ration:

10 lbs. of alfalfa hay
30 lbs. of corn silage
8 lbs. of dent corn

Work out for the above ration the data called for on page 26. Compute all decimals to the third place and the cost to tenths of a cent, following the general rule for dropping decimal places given in Exercise 1. This ration is not an ideal one, as will be brought out later in Exercise 8. It is given as a fairly satisfactory ration for cows of medium production which can be made up from the few feeds which have thus far been studied.

Summary table.—In computing rations for different classes of animals it will be found convenient to have the data for the different feeds which have been studied arranged in tabular form according to character of feed, i.e., concentrate or roughage, and also according to the protein content. The data called for in the **Summary Table** of the manual, pages 162 to 165, should therefore be filled in for the feeds which have been studied, and similar entries made as new feeds are studied.

Classification of feeds according to crude protein content.—For purposes of convenience in computing rations, as will appear later, all feeds may be arranged in three groups according to their relative amounts of crude protein. The proportion of crude protein is shown by the nutritive ratio. Low protein feeds are those with a nutritive ratio of 1:6.0 or wider. Medium protein feeds are those with a nutritive ratio of 1:3.1 to 1:6.0. High protein feeds are those with a nutritive ratio of 1:3.0 or narrower. The feeds to be studied in the manual are arranged in their respective classes in the **Summary Table**. Learn into which group each feed which is studied falls. This knowledge will enable one easily to combine feeds into a ration having the desired nutritive ratio.

FEED STUDY BLANK

Name of feed..

Source and definition...

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COMPOSITION OF 100 POUNDS OF FEED

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	......	......	......	......	......	....	
Coefficient of digestibility..............	......	......	......	......	......	....	
Digestible...........	......	......	......	......	......	......	......
				....			

Total dig. nutr. in 2,000 lbs................ Nutritive ratio................

Price per ton $.................. Weight of 1 quart...................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Name of feed ....

Source and definition ....

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COMPOSITION OF 100 POUNDS OF FEED

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Coefficient of digestibility	....	....	....	....	....	....	
Digestible	....	....	....	....	....	....	....
				$\underbrace{\hspace{4em}}_{\dots\dots\dots\dots}$			

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $.................. Weight of 1 quart.....................lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein.................. (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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FEED STUDY BLANK

Name ....

Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM

Computed from data in Exercise........

Feeds	Dry matter	Dig. crude protein	Dig. carbohydrates	Dig. fat	Cost
	Lbs.	Lbs.	Lbs.	Lbs.	Cents
Totals					

Nutritive ratio of ration is..............

Weight of one quart of concentrates is .... lbs.

How would you improve this ration? (This question is to be answered when Exercise 8 is studied.)

EXERCISE 3

THE WOLFF-LEHMANN STANDARDS

Feed studies.—In the previous exercises, the digestible crude protein, carbohydrates, and fat and the total digestible nutrients have been computed for each feed. In this and the following exercises these figures may be copied directly from Appendix Table III of the text, as sufficient practice should have now been secured in these simple computations. For this reason, the spaces for "Coefficients of digestibility" have been omitted in the feed study blanks for this and the following exercises.

Make complete studies of the following feeds:

Ground dent corn, $............ per ton. Use the same figures from Appendix Tables I and III as for "Dent corn" in Exercise 2. To the cost of shelled dent corn add the cost of grinding to get the price per ton of ground corn. For each class of stock tell whether it pays to grind shelled corn before feeding.

Corn-and-cob meal, $............ per ton. On the average, 80 per ct. of the weight of corn-and-cob meal is corn grain. Therefore, a ton of corn-and-cob meal will contain 1,600 lbs. corn grain and 400 lbs. cobs. To find the cost per ton of corn-and-cob meal, compute the cost of 1,600 lbs. shelled corn, deduct the cost of shelling it, and add the cost of grinding the ton of ear corn to corn-and-cob meal. In your notes state for each class of stock whether there is any advantage in using corn-and-cob meal.

Hominy feed, $............ per ton. While practically all the hominy feed on the market is a high grade feed, the composition varies somewhat, depending on whether some of the corn oil has been expressed, and on whether all the corn germs are included or not. Find how the guaranteed composition of the hominy feed available in your locality compares with the average composition given in Appendix Table I.

Gluten feed, $............ per ton. With the coming of national prohibition and the consequent great decrease in the amount of distillers' dried grains and of brewers' dried grains on the market, gluten feed has become even more important than before as a dairy feed.

Problem.—The Wolff-Lehmann standards are now out-of-date and do not meet present day conditions. Therefore they should not be used in computing rations for practical stock feeding, but instead one of the modern sets of standards, such as the Morrison (Modified Wolff-Lehmann) standards or the Armsby standards. However, on account of the historical importance of the Wolff-Lehmann standards, any thoro student of live stock feeding should understand this system of computing rations. They are still used to a considerable extent by those not familiar with recent developments in animal nutrition and stock feeding.

Compute according to the Wolff-Lehmann standards a ration for a dairy cow weighing 1,000 lbs. and yielding daily 22 lbs. of milk of average quality. Use the following feeds: red clover hay, corn silage, corn-and-cob meal, and gluten feed.

Before attempting this problem read carefully Parts I, II, and III of Chapter VII of *Feeds and Feeding* or Parts I and II of Chapter VII of *Feeds and Feeding, Abridged,* whichever is used as the text. Follow the rule on page 116 of *Feeds and Feeding* and page 88 of *Feeds and Feeding, Abridged* in deciding how much roughage and how much concentrates to give the cow.

As is explained in the text the allowance of protein prescribed in any standard is the minimum amount advised, and when protein-rich feeds are lower in price than those rich in carbohydrates, it is economy to supply more protein than called for by the standard. In this exercise, however, balance the ration so that the nutritive ratio is within 0.2 of that advised in the standard. The total digestible nutrients should be within 0.5 lb. of that of the standard. As is pointed out in the text (page 118 of *Feeds and Feeding* and page 92 of *Feeds and Feeding, Abridged*), American rations will usually contain more fat than called for by the Wolff-Lehmann standards. In such cases the amount of carbohydrates may fall somewhat below, as an offset. Simply balance the ration so that the amount of total digestible nutrients and the nutritive ratio are sufficiently close to the requirements of the standard.

The complete Wolff-Lehmann standards for all classes of animals are found in Appendix Table IV of the text.

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Name..

Source and definition...

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total...............	....	....	....	....	....	....	
Digestible...........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart.......................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Name..

Source and definition...

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	....	....	....	....	....	....	
Digestible...........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Name..

Source and definition..

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total............	......	......	......	......	......	......	
Digestible........	......	......	......		......	......	......

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio..............

Price per ton $................ Weight of 1 quart.......................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Name...

Source and definition...

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..........	....	....	....	....	....	....	
Digestible..........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM—WOLFF-LEHMANN STANDARD

Computed from data in Exercise No......

Standard meeting requirements of problem above:

Dry matter......................lbs. Dig. protein....................lbs.

Dig. carbohydrates...............lbs. Dig. fat........................lbs.

Total dig. nutr..................lbs. Nutritive ratio....................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Dig. carbo-hydrates	Dig. fat	Cost
	Lbs.	Lbs.	Lbs.	Lbs.	Cents
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
....	....	....	....	....	....
Totals..................	....	....	....	....	....

Nutritive ratio of ration is................

Lbs. of total dig. nutr. in ration................

Weight of one quart of the mixture of concentrates ....

What is your opinion of the above ration?

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EXERCISE 4

THE ARMSBY STANDARDS

Feed studies.—Make complete feed studies of the following feeds:

Germ oil meal, $. . . . . per ton. Before the World War a large part of the germ oil cake produced in this country was exported to Europe. Now much more of this feed is being used in the United States.

Wheat (whole or ground) $. . . . . per ton. Tho good grade wheat is not commonly fed to stock, it is important to know its feeding value, for wheat which is unsuited for milling may be an economical feed for stock.

Wheat bran, $. . . . . per ton. Since wheat bran is one of the most important feeds in the United States, be sure you discuss its value thoroly. At present prices is it an economical feed?

Standard wheat middlings (shorts) $. . . . . per ton. For what class of animals are middlings chiefly used. At present prices should middlings be used as a substitute for grain, or merely as a protein-rich feed to balance the ration?

Problem A.—Read over carefully the discussion of the Armsby feeding standards in Chapter VII of your text. Then formulate on page 49 a ration according to the Armsby standards for maintaining a 1,000-lb. steer, using only the feeds which have been studied. By taking into consideration the principles emphasized in the discussion of "Heat and energy required for maintenance" in Chapter IV, how can you make a cheaper ration by using feeds which have not yet been studied?

Problem B.—A dairy cow weighing 1,250 lbs. yields daily 38 lbs. of milk testing 4 per ct. butter fat. Formulate from the feeds that have been studied a ration for her, according to the Armsby standard. This provides a minimum amount of digestible true protein and of net energy. In computing the ration the digestible protein should not exceed that in the standard by more than 0.5 lb. The therms of net energy should not exceed the standard by more than 0.5 therm. Work out the problem on page 50.

FEED STUDY BLANK

Name..

Source and definition...

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total							
Digestible							

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart.......................lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein.................. (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart ....lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein ....(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM—ARMSBY STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dig. protein........................lbs. Net energy.................therms

Ration computed according to standard above:

Feeds	Dry matter	Dig. protein	Net energy	Cost
	Lbs.	Lbs.	Therms	Cents
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
Totals..	....	....	....	....

What is your opinion of the above ration? Can you suggest improvements in it?

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PROBLEM—ARMSBY STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dig. protein........................lbs. Net energy................therms

Ration computed according to standard above:

Feeds	Dry matter	Dig. protein	Net energy	Cost
	Lbs.	Lbs.	Therms	Cents
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
Totals..................................	....	....	....	....

What is your opinion of the above ration? Can you suggest improvements in it?

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EXERCISE 5

MORRISON (MODIFIED WOLFF-LEHMANN) FEEDING STANDARDS

Feed studies.—Make complete studies of the following feeds:

Wheat middlings, flour, $. . . . . per ton. For what class of animals is flour middlings most commonly used? What has been the usual difference in price per ton during the past year in your locality between standard middlings and flour middlings?

Red dog flour, $. . . . . per ton. Do you think red dog flour is an economical feed at present prices? For what animals would you use it?

Wheat mixed feed, $. . . . . per ton. What is the relative feeding value of wheat mixed feed and wheat bran?

Oats (whole or ground), $. . . . . per ton. State the extent to which you would use oats in feeding the various classes of stock. Which is the cheaper feed at present prices, corn or oats?

Problem A.—Study carefully the discussion of the Morrison (Modified Wolff-Lehmann) feeding standards in Chapter VII of your text. Then work out in accordance with these standards as economical a ration as possible for a dairy cow weighing 1,200 lbs., and yielding daily 30 lbs. of milk testing 3.5 per ct. of butter fat.

It will be noted that a range is indicated in the amounts of digestible crude protein advised for each pound of milk produced. The lower amounts are those recommended by Haecker and the higher amounts those advised by Savage. In this ration feed as much protein as is indicated in the higher figures, provided as cheap a ration can be secured as when the lower recommendations are followed.

The complete Morrison (Modified Wolff-Lehmann) feeding standards for all classes of animals are given in Appendix Table V of your text.

Problem B.—Compute a ration according to the Morrison (Modified Wolff-Lehmann) standards for a 1,400-lb. horse at medium work. No succulent feed is necessary. The weight per quart of concentrates is not important. How would you change this ration on idle days, such as Sundays or holidays?

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Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total							
Digestible							

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....		....	....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio................

Price per ton $................ Weight of 1 quart.......................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....	....	....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart ....lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein ....(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Source and definition...

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............							
Digestible...........							

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio..............

Price per ton $................ Weight of 1 quart.......................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No.........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein..................lbs.

Total dig. nutr.......................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
Totals..................................	....	....	....	....

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein..................lbs.

Total dig. nutr......................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
Totals				

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

EXERCISE 6

ECONOMY IN FEEDING LIVE STOCK

Feed studies.—Make complete studies of the following feeds:

Barley (whole or ground), $. . . . . per ton. In many districts of the northern states barley yields considerably more pounds of grain per acre than oats. Is barley or oats the more profitable crop in your section, considering the yield per acre (pounds, not bushels) and the feeding value of the grain?

Brewers' dried grains (over 25 per ct. protein), $. . . . . per ton. The amount of brewers' dried grains produced in the United States has of course decreased greatly since national prohibition. Some are still produced, however, as a by-product in the manufacture of near beer, etc.

Rye (whole or ground), $. . . . . per ton. Is rye commonly grown in your state? How does rye compare with the other small grains in yield of grain per acre (pounds, not bushels)?

Kafir grain (whole or ground), $. . . . . per ton. Of what importance are the grain sorghums in your district? If grown, how do the yields of kafir and milo compare with corn? Which is more profitable to grow for stock feeding?

Buckwheat middlings, $. . . . . per ton. In what states is most of the buckwheat grown? Do you find buckwheat middlings or buckwheat feed on your local market?

Problem A.—Study Chapter VIII of your text thoroly. Be sure you have entered in the *Summary Table* of the Manual all the data required for each of the feeds you have studied. Go over this table carefully and note which concentrates and which roughages supply total digestible nutrients most cheaply. Also note which furnish digestible crude protein most economically.

Compute according to the Morrison (Modified Wolff-Lehmann) feeding standards the most economical, satisfactory ration possible for a 900-lb. cow producing daily 25 lbs. of 5 per ct. milk. Take only the feeds which have been studied thus far. Use the same method as is followed in Chapter VIII of your text. Be sure your ration is as cheap as possible, but at the same time satisfactory for milk production.

Problem B.—Study the ration worked out on page 26 (Exercise 2). How can you modify this ration so as to make it more satisfactory and also more economical? Write your suggestions on page 26.

FEED STUDY BLANK

Name ....

Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	......	......	......	......	......	......	
Digestible	......	......	......	....		......	......

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	....	....	....	....	....	....	
Digestible..........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....		....	....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart ....lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein ....(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein..................lbs.

Total dig. nutr......................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
Totals..	....	....	....	....

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

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EXERCISE 7

MANURIAL VALUE OF FEEDING STUFFS

Feed studies.—Make complete studies of the following feeds:

Cottonseed meal, choice, $............ per ton. Be sure and discuss the feeding value of cottonseed meal for the various classes of stock thoroly. How widely is it fed in your locality? If it is not commonly used, do you believe it should be used more commonly at present prices?

Cottonseed meal, good, $............ per ton. In your notes state the differences between choice cottonseed meal, prime cottonseed meal, good cottonseed meal, and cottonseed feed. At present prices is good cottonseed meal or choice cottonseed meal the more economical feed? If cottonseed feed is sold in your locality, figure out whether it is an economical purchase or not compared with cottonseed meal.

Linseed meal, old process, $............ per ton. Disregarding its tonic and regulating effects, which is more economical at present prices, linseed meal or choice cottonseed meal? Which is more commonly fed in your locality?

Peanut meal, $............ per ton. Is peanut meal available in your local feed stores or is it quoted by wholesalers in your state? Which is the more economical feed, cottonseed meal, linseed meal, or peanut meal?

Problem A.—To secure the greatest profit from stock farming it is vitally necessary to understand not only the feeding values of various feeds, but also to appreciate their manurial values. Study thoroly Chapter XVII of your text. Then work out the following problem, putting your computations on page 86.

Compute the manurial value per ton for the following feeds, using the prices for nitrogen, phosphoric acid, and potash given by the instructor: (1) Ground corn, (2) Wheat bran, (3) Gluten feed, (4) Choice cottonseed meal. Deduct the manurial value per ton from the gross cost of the feed per ton, to secure the actual net cost on farms where additional fertility is needed (as is the case on most farms). Then compute the net cost of each feed per pound of total digestible nutrients after allowing the credit for the manurial value. Tabulate your results neatly, putting the following figures in separate columns: (a) Gross cost per ton; (b) Manurial value per ton; (c) Net cost per ton; (d) Net cost of 1 pound total digestible nutrients.

If you need more fertility on a farm, which of these feeds are actually the cheapest? Because they fail to appreciate the high manurial value of protein-rich feeds, many farmers often think such feeds as cottonseed meal or linseed meal unduly expensive.

Problem B.—Find the local prices paid farmers for fat pigs, fat steers, whole milk and butter. Then compute the value of the fertility removed from the farm in selling $200.00 worth of each of these products. The fertilizing constituents in 1,000 lbs. of these animal products are given in the table on page 275 of *Feeds and Feeding* and on page 215 of *Feeds and Feeding, Abridged.* Use the same values for nitrogen, phosphoric acid, and potash as in the previous problem.

Also compute the fertilizing constituents removed from the farm in selling $200.00 worth of timothy hay and of red clover hay. In making this comparison one should of course recognize the fact that all the nitrogen in red clover hay did not come from the soil.

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....	....	....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total							
Digestible							

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	....	....	....	....	....	....	
Digestible..........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart.......................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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EXERCISE 8

COMMERCIAL MIXED FEEDS

Feed studies.—Make complete studies of the following feeds:

Cocoanut meal, $............ per ton. Is cocoanut meal used as yet in your locality? How does it compare in economy with the other protein-rich concentrates which have been studied?

Field peas, $............ per ton. Field peas are an excellent concentrate for stock. However, the price paid for field peas for seed and for soup peas is quite often so high that it is more profitable to sell field peas and purchase other protein-rich feeds.

Skim milk, $............ per ton. In deciding how to dispose of his milk, it is important for the dairyman to understand the value of skim milk and the other dairy by-products.

Tankage or meat meal (over 60% protein), $............ per ton. For what class of animals is tankage chiefly used? How much tankage is needed to balance corn for pigs of various weights (a) in dry lots, (b) on good pasture?

Problem A.—Find out the retail price charged for a representative mixed commercial dairy feed on your local market and also the guaranteed composition and the average actual composition as determined by the feed control officials of your state. Also ascertain the ingredients of which the feed is made.

Then figure out on page 97 an economical mixture of concentrates, using so far as possible the ingredients of the mixed feed, which will furnish as much total crude protein and total fat and no more total crude fiber than the mixed feed has been found to contain by the feed control officials. Compare the cost of this mixture per ton, taking the local prices for the feeds used in it, with the price of the mixed feed.

If possible make up 1,000 lbs. of such a mixture of feed and determine how long it takes you. It will be found by experience that in mixing feeds on the farm, shovelling the feed over three times on a smooth floor with an ordinary scoop shovel will mix it sufficiently well for the needs of farm animals. It should not require more than 3 hours time of one man to empty, mix, and rebag a ton of feed. At the current prices is the mixed commercial feed or the home mixture the more economical?

Problem B.—Compute the dry matter, digestible crude protein, and total digestible nutrients in 100 lbs. of the home mixture. As digestion trials have been carried on with but very few mixed feeds, it will be necessary to assume that the mixed commercial feed studied in the previous problem furnishes the same amount of digestible nutrients as the home mixture. Using the mixed commercial feed as one of the components, compute as economical a ration as possible according to the Morrison (Modified Wolff-Lehmann) standards for a 900-lb. dairy cow yielding daily 25 lbs. of 5 per cent milk. How does this ration compare in economy with the ration computed in the problem in Exercise 6? Put your computations on page 98.

FEED STUDY BLANK

Name..

Source and definition..

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total...............	....	....	....	....	....	....	
Digestible...........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	....	....	....	....	....	....	
Digestible..........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Source and definition...

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	....	....	....	....	....	....	
Digestible..........	....	....	....	....	....	....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart.........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein ....lbs.

Total dig. nutr.....................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
Totals				

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

EXERCISE 9

THE FEEDING OF HORSES

Feed studies.—Make complete studies of the following feeds:

Blood meal, $............ per ton. Blood meal or dried blood is commonly used only for calves.

Dried beet pulp, $............ per ton. For what class of animals is dried beet pulp chiefly used in your locality? How does it compare with other carbonaceous concentrates in cost of 1 lb. of total digestible nutrients?

Cane molasses, $............ per ton. Should cane molasses be commonly used in your section with feeds at present prices?

Corn fodder (*medium in water*), $............ per ton. It is important to realize that corn fodder and corn stover vary widely in water content and hence in feeding value per ton. Which is the most economical feed, corn silage or corn fodder?

Oat straw, $............ per ton. For what classes of animals can straw be economically used to a considerable extent?

Problem A.—If using *Feeds and Feeding* as the text, study carefully Part I of Chapter XVIII, especially Articles 447–57, and also Article 530 in Chapter XX. If using *Feeds and Feeding, Abridged* as the text, study Chapter XVIII, especially pages 222–4 and pages 227–8.

Then compute on page 110 a ration according to the Morrison (Modified Wolff-Lehmann) feeding standards for a 1,500-lb. farm horse at hard work. Make the ration as cheap as possible, but be sure it is an efficient and satisfactory one.

Problem B.—Compute on page 111 a ration for the same horse when idle, likewise using the Morrison (Modified Wolff-Lehmann) feeding standards. How does this ration differ from the one just computed?

Problem C.—Study Articles 514 and 515 of *Feeds and Feeding* or pages 230–231 of *Feeds and Feeding, Abridged*, whichever is used as the text. Then compute on page 112 a ration for a 1,600-lb. brood mare, suckling a foal, using the Morrison (Modified Wolff-Lehmann) feeding standards.

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Source and definition . . . .

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	
Digestible	. . . .	. . . .	. . . .	. . . .		. . . .	. . . .

Total dig. nutr. in 2,000 lbs . . . . Nutritive ratio . . . .

Price per ton $ . . . . Weight of 1 quart . . . . .lbs.

Cost of 1 lb. total dig. nutr. . . . .(to hundredths of a cent)

Cost per lb. digestible crude protein . . . .(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Name ....

Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....	....	....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Name..

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	....	....	....	....	....	....	
Digestible..........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart.........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Name of feed..

Source and definition..

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COMPOSITION OF 100 POUNDS OF FEED

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total...............	....	....	....	....	....	....	
Coefficient of digestibility...............	....	....	....	....	....	....	
Digestible...........	....	....	....	....	....	....	....
				....			

Total dig. nutr. in 2,000 lbs................ Nutritive ratio.................

Price per ton $.................. Weight of 1 quart....................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein..................lbs.

Total dig. nutr.....................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
Totals				

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein..................lbs.

Total dig. nutr.....................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
Totals............................	......	......	......	......

Nutritive ratio of ration is...............

Weight of one qt. of concentrate mixture (in rations for dairy cows) ....

What is your opinion of this ration? Can you improve it?

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein..................lbs.

Total dig. nutr.......................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
Totals..................................	......	......	......	......

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

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EXERCISE 10

THE FEEDING OF DAIRY CATTLE

Feed studies.—Make complete studies of the following feeds:

Corn stover, medium in water, $............ per ton. How can corn stover be most economically utilized in stock feeding?

Green corn fodder, $............ per ton. Use figures from Appendix Table III of your text for "Green corn fodder, all analyses." Green corn fodder is used chiefly for dairy cattle, but may also be fed to beef cattle and horses not at hard work. Standing corn is often "hogged down" or "sheeped down."

Sorghum fodder, $.................... per ton. Are either the sweet sorghums or the grain sorghums important forage crops in your locality? What is the comparative yield of sweet sorghum fodder and corn fodder?

Hay from clover and mixed grasses, $............ per ton. (Use the figures in Appendix Table III for "Clover and mixed grasses.") Your text gives little discussion of mixed hay as such, for its value varies widely, depending on the proportion of clovers or other legumes in the hay, and on the varieties of grass present. Much more mixed clover and timothy hay is grown in the United States than of any other kind of hay. Mixed hay will be found useful in place of timothy or clover hay and may be used in the same manner.

Problem A.—If *Feeds and Feeding* is used as the text, study thoroly Part I of Chapter XXI and also Chapter XXIV, especially Articles 658–664. If you are using *Feeds and Feeding, Abridged* as the text, study carefully Parts I and III of Chapter XX, especially pages 259–261.

Compute on page 123 the most economical ration possible according to the Morrison (Modified Wolff-Lehmann) feeding standards for a 1,000-lb. cow producing daily 30 lbs. of 3.5 per ct. milk. Feed 1 lb. of hay and 3 lbs. of silage per 100 lbs. live weight unless directed otherwise by the instructor. How does the amount of concentrates required compare with the common rule "Feed 1 lb. of concentrates per day for each pound of butter fat the cow produces per week?"

What is the cost of feed for 100 lbs. of milk? For each pound of butter fat?

Problem B.—In the practical feeding of dairy herds a balanced ration is not commonly figured out for each cow in the herd. A good method is to compute a ration for an average cow and then to feed the same concentrate mixture and roughages to the rest of the herd, but to adjust the amount fed to each cow of the concentrate mixture and of roughage according to one of the common "thumb" rules, such as those stated in the previous problem.

Compute on page 124 a ration for a 1,000-lb. cow yielding daily 20 lbs. of 3.5 per ct. milk. Use the same kinds and amounts of roughage as in the previous ration. Also feed the same concentrate mixture, but decrease the amount, following the thumb rule given before. It will simplify the work in this and the following problem to compute first the dry matter, the digestible protein, and the total digestible nutrients in 100 lbs. of the concentrate mixture. Then use this mixture as if it were a single feed with this content of digestible nutrients. How does this ration agree with the requirements according to the Morrison (Modified Wolff-Lehmann) feeding standards?

Problem C.—In the same manner compute on page 125 a ration for a 1,000-lb. cow yielding 60 lbs. of 3.5 per ct. milk. How does the ration agree with the requirements according to the standards?

Problem D.—Compute a ration for a 1,400-lb. cow yielding 30 lbs. of 3.5 per ct. milk. Use the same concentrate mixture as before and feed according to the thumb rule. Use the same roughage, but increase the amount to correspond with the weight of the cow.

The foregoing problems will show how a mixture of concentrates may be made up and the amount fed each animal adjusted to her requirements. If there is insufficient time for each member of the class to work all these problems, it is suggested that all work Problem A and that Problems B, C, and D be then assigned to different sections of the class and the rations discussed later in the class.

FEED STUDY BLANK

Name..

Source and definition..

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total							
Digestible							

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....				....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total							
Digestible							

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	....	....	....	....	....	....	
Digestible..........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................... Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter..........................lbs. Dig. protein..................lbs.

Total dig. nutr.....................lbs. Nutritive ratio....................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
Totals..................................	....	....	....	....

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein..................lbs.

Total dig. nutr......................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
Totals...........................	....	....	....	....

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein..................lbs.

Total dig. nutr......................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
Totals..................................	......	......	......	......

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

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EXERCISE 11

THE FEEDING OF BEEF CATTLE

Feed studies.—Make complete studies of the following feeds:

Oat and pea hay, $. . . . . per ton. When cut at the right stage of maturity and well cured, this hay is valuable, especially for dairy cattle, and may be used as a substitute for clover or alfalfa hay.

Sudan grass hay, $. . . . . per ton. Is Sudan grass grown to any extent in your section?

Study whichever of the following legumes is more important in your district.

Cowpea hay, $. . . . . per ton. Cowpeas are the most common legume in the cotton belt, but are not well adapted to the extreme northern states.

Soybean hay, $. . . . . per ton. Should the acreage of soybeans grown for forage be increased in your locality?

Problem A.—Study carefully the discussion of "Margin" in your text. Then work out the following problem.

A man buys 1,000-lb. steers in thin flesh at $12.00 per cwt. and feeds them an average ration of 16 lbs. shelled corn, 2.75 lbs. cottonseed meal, 15 lbs. corn silage, and 5 lbs. clover hay for 120 days. In steer feeding it is commonly assumed that the value of the manure produced by the steers and the pork made by the hogs following the steers will pay for the costs other than the feed. During this period the average daily gain of the steers is 2.5 lbs. With shelled corn at $1.40 per bushel, and cottonseed meal at $70.00 per ton, corn silage at $8.50 per ton and clover hay at $25.00 per ton, what must the steers sell for per cwt. to break even on the transaction? What is the necessary margin in this feeding operation? Summarize your computations on page 133.

Problem B.—Taking the data given in Problem A, find the necessary margin if the steers had weighed 900 lbs. at the start.

Supposing they had weighed 1,000 lbs. and were fed 90 days, consuming the same ration and making the same gains as in Problem A, what would be the necessary margin?

What will be the necessary margin if corn costs $1.00 per bushel and cottonseed meal $60.00 per ton?

From the results obtained state how initial cost, initial weight, length of feeding period, and cost of feeds influence the necessary margin.

Problem C.—If using *Feeds and Feeding* as the text, study Part I of Chapter XXVI and also Chapter XXIX, or if your text is *Feeds and Feeding, Abridged,* study Chapter XXIII. Then work out the following problem on page 136.

Two-year-old feeder steers of good quality, averaging 950 lbs. when placed in the feed lot, are to be fed during the winter for 120 days so as to make an average daily gain of 2.3 lbs. As steers fatten they consume a smaller proportion of roughage. This is recognized in the recommendations of the Morrison (Modified Wolff-Lehmann) standards for the first, middle, and last periods of fattening. Using the same feeds for each period but varying the proportion as necessary, compute the best and cheapest ration for each period. Base the ration on the average weight of the steers at the middle of each period, not on the initial weight. Use page 136 for the ration for the first period and tabulate rations for the other periods in the same manner on page 137.

FEED STUDY BLANK

Name . . . .

Source and definition . . . .

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	. . . .	. . . .	. . . .	. . . .	. . . .	. . . .	
Digestible	. . . .	. . . .	. . . .	. . . .		. . . .	. . . .

Total dig. nutr. in 2,000 lbs . . . . Nutritive ratio . . . .

Price per ton $ . . . . Weight of 1 quart . . . . lbs.

Cost of 1 lb. total dig. nutr. . . . . (to hundredths of a cent)

Cost per lb. digestible crude protein . . . . (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....	....	....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter.......................lbs. Dig. protein..................lbs.

Total dig. nutr.....................lbs. Nutritive ratio.................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
....	......	......	......	......
Totals..................................	......	......	......	......

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

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EXERCISE 12

THE FEEDING OF SHEEP

Feed studies.—Make complete studies of the following feeds:

Alfalfa, green, $. . . . . per ton. Discuss the value of alfalfa soilage and also alfalfa pasture.

Red clover, green, $. . . . . per ton. Discuss the use of red clover as a soiling crop and also as pasture.

Study whichever of the following is more important in your district:

Oats and peas, green, $. . . . . per ton. *Cowpeas, green* $. . . . . per ton.

Problem A.—If *Feeds and Feeding* is your text study carefully Part II of Chapter XXXII, or if you are using *Feeds and Feeding, Abridged,* study pages 330–333. Then compute according to the Morrison (Modified Wolff-Lehmann) feeding standards the ration you would recommend for fattening a carload of western lambs, averaging 55 lbs. when placed on feed and to be fed until they reach an average weight of 85 lbs. Compute on page 145 the ration for the middle of the feeding period, when the lambs will be on full feed. How would you change this ration in starting the lambs on feed? What should the average daily gain of the lambs be on your ration? How long will it take them to reach 85 lbs.?

Problem B.—Figure out on pages 146 and 147 the return you would have probably realized last winter in feeding a carload of western lambs the above ration. Make the problem real. Look up the quotations for feeder lambs and for fat lambs on the dates you would have purchased the lambs and sold them. Include all costs of purchasing and selling the lambs—freight, commission, etc. Assuming that the value of the manure will offset the cost of the labor, what would have been the net return, not making any deduction for interest, cost of shelter, and possible death losses of lambs?

Problem C.—Formulate on page 148 a ration for a pen of 8 breeding ewes, weighing 125 lbs. each, which are suckling winter lambs. Study the paragraphs in your text on feeding breeding ewes. Use the Morrison (Modified Wolff-Lehmann) standards for breeding ewes with lambs, and employ any of the feeds that have been studied which are useful for sheep. For succulence feed silage from well-matured corn or else feed roots, depending on which crop can be produced more cheaply in your section. The dry matter in the roughage, including succulent feed, and in the concentrates should be about equal.

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Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $................ Weight of 1 quart ....lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total..............	....	....	....	....	....	....	
Digestible..........	....	....	....	....	....	....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein..................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total........	......	......	......	......	......	......	
Digestible........	......	......	......	....		......	......

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter........................lbs. Dig. protein..................lbs.

Total dig. nutr.....................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
Totals....................................	....	....	....	....

Nutritive ratio of ration is................

Weight of one qt. of concentrate mixture (in rations for dairy cows)..............

What is your opinion of this ration? Can you improve it?

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PROBLEM—MORRISON STANDARD

Computed from data in Exercise No........

Standard meeting requirements of problem above:

Dry matter............................lbs. Dig. protein..................lbs.

Total dig. nutr.......................lbs. Nutritive ratio..................

Ration computed according to standard above:

Feeds	Dry matter	Dig. crude protein	Total dig. nutrients	Cost
	Lbs.	Lbs.	Lbs.	Cents
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
....	....	....	....	....
Totals..................................	....	....	....	....

Nutritive ratio of ration is...............

Weight of one qt. of concentrate mixture (in rations for dairy cows).............

What is your opinion of this ration? Can you improve it?

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EXERCISE 13

THE FEEDING OF SWINE

Feed studies.—Make complete studies of the following feeds:

Green rape, $. . . . . per ton. Rape is often used as soilage, especially for sheep, but is more commonly used for pasture.

Mangels, $. . . . . per ton. Are roots commonly grown for stock feeding in your locality? If so, to what classes of stock are they fed? Should they be more largely used for stock?

Rutabagas, $. . . . . per ton.

This completes the study of 50 common feeds used for animals in the United States. Many other feeds might be studied in the same way. Those feeds which have been studied represent perhaps those most widely used. It is expected that the teacher and student will not confine themselves in actual practice to the feeds that have been presented here. The usefulness of a feed is governed largely by the supply and price. A successful practical feeder must familiarize himself with all feeds available and study their true relative values.

Problem A.—Compute rations according to the Morrison (Modified Wolff-Lehmann) feeding standards for growing, fattening pigs of the following weights: 40 lbs., 75 lbs., 125 lbs., and 175 lbs., using for each weight the proper proportions of whichever of the following combinations of feeds is most economical under your local conditions:

Shelled corn and tankage.
Shelled corn and skim milk.
Ground barley and skim milk.
Ground milo and tankage.

What do these rations teach you as to the proportion of protein-rich feed needed for pigs of various ages?

References for this problem are *Feeds and Feeding*, Chapter XXIII, especially Articles 913 and 918, also Chapter XXXV, Articles 1022–3; or *Feeds and Feeding, Abridged*, Chapter XXVII, especially pages 347–52, and 358–60.

Problem B.—Suggest a pasture system adapted to your section for carrying 40 April pigs thru the summer to a weight of 225 lbs. Calculate the necessary acreage of each crop and the necessary kinds and amounts of grain and supplementary feeds fed in a self-feeder. Compute the cost of these concentrates, and then the cost of concentrates required for each 100 lbs. gain. Find out the selling price of hogs (live weight). Deduct the cost of concentrates required for 100 lbs. gain from the selling price per cwt. to find the amount received over and above the cost of concentrates to pay for labor, rent of land, equipment, maintenance of brood sows, boar service, and other overhead charges.

FEED STUDY BLANK

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Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutri-ents
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutri-ents
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total...............	....	....	....	....	....	....	
Digestible...........	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs.................. Nutritive ratio...............

Price per ton $................ Weight of 1 quart.........................lbs.

Cost of 1 lb. total dig. nutr. ....(to hundredths of a cent)

Cost per lb. digestible crude protein...................(to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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Source and definition ....

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COMPOSITION OF 100 POUNDS

	Dry matter	Ash	Crude protein	Carbohydrates		Fat	Total dig. nutrients
				Fiber	N-free extract		
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Total	....	....	....	....	....	....	
Digestible	....	....	....	....		....	....

Total dig. nutr. in 2,000 lbs .... Nutritive ratio ....

Price per ton $ .... Weight of 1 quart .... lbs.

Cost of 1 lb. total dig. nutr. .... (to hundredths of a cent)

Cost per lb. digestible crude protein .... (to hundredths of a cent)

Palatability, usefulness, and limitations for horses, dairy and beef cattle, sheep, and swine:

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EXERCISE 14

SILOS AND SILAGE

Problem A.—A farmer wishes to provide corn silage for a herd of 16 Guernsey cows averaging 950 lbs. in weight, 7 yearling heifers, 2 idle horses, and 30 breeding ewes, during a winter feeding period of 6 months. How much silage will be fed daily from the silo? What size of silo would you recommend on this farm?

For this problem and those following use the blank pages at the back of the manual.

Problem B.—A silo 14 feet in diameter has 10 feet of average corn silage left in the bottom. Before any silage had been removed in the fall the total depth of silage in the silo was 26 feet. How many tons of silage are there left in the silo?

EXERCISE 15

Problem A.—In many instances it is possible to market farm-grown grains and with the proceeds purchase protein-rich by-product concentrates, which not only aid in balancing the ration, but also bring fertility to the farm. Determine the gain or loss in selling 10 tons of corn and purchasing cottonseed meal with the proceeds, with these feeds at the local market prices. Assume that to supplement the feeds available on the farm, the feeding value of the cottonseed meal is enough greater than corn to cover the cost of the hauling.

Problem B.—Taking the manurial value of the feed into consideration (see Exercise 7), compare the net cost of Mixture A with Mixture B: *Mixture A.*—1,000 lbs. of oats, 1,000 lbs. of barley, 1,000 lbs. corn meal, and 1,000 lbs. of oil meal. *Mixture B.*—1,000 lbs. gluten feed, 1,000 lbs. wheat bran, 1,000 lbs. cottonseed meal, 500 lbs. corn meal, and 500 lbs. of oil meal. Compute the manurial value on the assumption that the above amounts of the two mixtures were fed to dairy cows. This problem will illustrate forcibly the advantages in buying protein-rich concentrates.

EXERCISE 16

Problem A.—Formulate a ration for a 1,000-lb. dairy cow producing 30 lbs. of 4 per ct. milk daily, according to the Morrison, or Modified Wolff-Lehmann, standards, feeding only as much digestible crude protein as is advised in the lower set of figures in the standards. Use the feeds grown in your locality and supplement the farm grown grains with 3 purchased feeds that will furnish the required additional nutrients most economically. If timothy hay is grown use it in the ration, and formulate a second ration using alfalfa or clover hay in place of the timothy and find the difference in cost at current prices. If corn silage is not grown, see if an addition of corn silage would improve the ration. Determine the feed cost per 100 lbs. milk and per pound fat with feeds at local prices.

Problem B.—Formulate a ration under the same conditions as in Problem A, using the higher set of figures for crude protein in the Morrison, or Modified Wolff-Lehmann, standards, and see if this narrower ration is more expensive than the previous ration.

EXERCISE 17

Problem A.—If you are in a market milk and also a creamery district, find out the price paid farmers per cwt. for milk testing 3.5 per ct. butter fat and the price paid at creameries per pound of butter fat. Otherwise, secure representative prices from the instructor.

Which is the most profitable way of marketing milk? Assume that if cream is sent to the creamery, from each 100 lbs. of milk produced 80 lbs. of skim milk will be available for feeding. When fed in proper amount to balance the ration, 100 lbs. of skim milk is worth one-half as much as a bushel of shelled corn. Take into consideration the fertility lost from the farm in the two methods of marketing the milk and any different in cost of hauling.

Problem B.—Outline a method and probable annual cost of feeding a herd of 25 cows on the average producing 350 lbs. of butter fat during an average lactation period of 10 months.

These cows must be well cared for during winter, and will require grain, good pasture, and some soilage or silage during the summer.

EXERCISE 18

Problem A.—A farmer grows alfalfa hay, corn silage, mangels, oats, Canada field peas and barley enough for his herd. Formulate a ration from the above feeds for a cow weighing 1,200 lbs. She yields daily 36 lbs. of milk testing 3.5 per ct. butter fat. Use equal parts by weight of oats, peas, and barley. Feed 30 lbs. of mangels in place of 3 lbs. of the usual allowance of concentrates.

This exercise shows the possibility of providing satisfactory rations with only home-grown feeds. With clover hay, it would be necessary to purchase some high protein concentrate. Oats and peas may be easily grown together for grain.

Problem B.—Suggest a soilage system for a herd of 25 cows from May 1 to November 1. The cows average 1,000 lbs. in live weight and yield daily an average of 30 lbs. of 4 per ct. milk. Allow them a liberal grain ration and calculate the necessary yield of each crop and the acreage. Estimate the total number of acres necessary to grow hay and silage for feeding from November 1 to May 1 and to grow the above amount of soilage. Suggest the rotation to be practiced.

EXERCISE 19

Problem.—On a 240 acre farm are 40 acres of pasture, woodlot, farmstead, etc., and 200 acres in tilled crops. Of the 200 acres, 15 acres are devoted to silage corn, 60 acres to corn for grain, 60 acres to small grain and 65 acres to clover hay. Suppose the silage corn yields 12 tons per acre, the 60 acres of corn yields 60 bushels of ear corn and 2.5 tons of stover per acre, the small grain returns the equivalent of 45 bu. of oats and 1.5 tons of straw, and the hay averages 1.75 tons per acre.

On this farm are kept an average of 25 brood sows and an average of 12 pigs are raised each year per sow, the sows having both fall and spring litters.

It is desired to feed the surplus roughage to cattle in winter or early summer for spring or summer market. Outline a method for the management of the feeding. Feed the cattle 120 days, have them bought at 1,000 lbs. weight, get them to gain an average of 2.5 lbs. daily. Study the actual markets in the live-stock market journals, learn the shrink to feed lots, if any, count in all buying expense and all selling expense, such as freight, commission charges, shrinkage, etc. There are also possible losses by deaths, etc. Consider also the value of the manure, estimating the probable amount which will be obtained. If necessary, supplement the farm grown feeds with linseed or cottonseed meal. Estimate the number of cattle that may be fed and watch for the time to market. It may be necessary to hold the cattle over 120 days or maybe they could be marketed earlier. Write up a connected report of the feeding operations.

EXERCISE 20

If possible, the instructor should secure samples of all the concentrates that have been studied. Require that each student identify all in a reasonable length of time.

Visit a good stock farm. Find out the ration and mixture of concentrates being fed to as many of the following as possible: (1) dairy cows, (2) bulls, (3) pregnant cows not giving milk, (4) calves, (5) young stock, (6) sheep, (7) lambs, (8) yearling colts, (9) two-year-old colts, (10) stallions, (11) breeding mares, (12) work horses, (13) mules, (14) young horses that are being fattened for market, (15) beef cattle, (16) brood sows, (17) swine being fattened for market. Write up a report pointing out any instances where you could suggest improvements in the rations being fed.

SUMMARY TABLE

Showing Relative Value of Feeds on the Basis of the Nutritive Ratio, the Cost of 1 lb. of Total Digestible Nutrients, and of 1 lb. of Digestible Crude Protein.

Feeds	Dry matter in 100 lbs.	Dig. crude protein in 100 lbs.	Total dig. nutrients in 100 lbs.	Nutritive ratio	Cost per lb. dig. crude protein	Cost of 1 lb. total dig. nutrients
Concentrates	Lbs.	Lbs.	Lbs.		Cents	Cents
Low protein, N. R. 1:6.1 or wider						
Dent corn	......	......	......	......	......	......
Ground corn	......	......	......	......	......	......
Corn-and-cob meal	......	......	......	......	......	......
Hominy feed	......	......	......	......	......	......
Wheat	......	......	......	......	......	......
Rye	......	......	......	......	......	......
Oats	......	......	......	......	......	......
Barley	......	......	......	......	......	......
Kafir	......	......	......	......	......	......
Beet pulp, dried	......	......	......	......	......	......
Molasses, cane	......	......	......	......	......	......
......	......	......	......	......	......	......
......	......	......	......	......	......	......
Medium protein N.R. 1:3.1 to 1:6.0						
Germ oil meal	......	......	......	......	......	......
Wheat bran, av. all analyses	......	......	......	......	......	......
Standard wheat middlings	......	......	......	......	......	......
Flour wheat middlings	......	......	......	......	......	......
Red dog flour	......	......	......	......	......	......
Wheat feed (shorts and bran)	......	......	......	......	......	......
Cocoanut meal	......	......	......	......	......	......
......	......	......	......	......	......	......
......	......	......	......	......	......	......

SUMMARY TABLE, *Continued*

Feeds	Dry matter in 100 lbs.	Dig. crude protein in 100 lbs.	Total dig. nutrients in 100 lbs.	Nutritive ratio	Cost per lb. dig. crude protein	Cost of 1 lb. total dig. nutrients
Concentrates, con.	Lbs.	Lbs.	Lbs.		Cents	Cents
High protein, N.R. 1:3.0 or narrower						
Gluten feed						
Brewers' grains, dried						
Buckwheat middlings						
Cottonseed meal, choice						
Cottonseed meal, good						
Linseed meal, old process						
Soybeans						
Peas, field						
Skim milk, centrifugal						
Tankage, over 55% protein						
Blood meal						
Dry Roughage						
Low protein, N.R. 1:6.1 or wider						
Corn fodder, medium in water						
Corn stover, medium in water						
Sorghum fodder, dry						
Timothy hay, all analyses						
Sudan grass hay						
Clover and mixed grass hay						
Oat straw						

SUMMARY TABLE, *Continued*

Feeds	Dry matter in 100 lbs.	Dig. crude protein in 100 lbs.	Total dig. nutrients in 100 lbs.	Nutritive ratio	Cost per lb. dig. crude protein	Cost of 1 lb. total dig. nutrients
Dry Roughages, con.	Lbs.	Lbs.	Lbs.		Cents	Cents
Medium protein, N.R. 1:3.1 to 1:6.0						
Alfalfa hay						
Red clover hay						
Soybean hay						
Peas and oats hay						
High protein, N.R. 1:3.0 or narrower						
Cowpea hay, all analyses						
Green Roughage and Silage						
Low protein, N.R. 1:6.1 or wider						
Corn silage, well-matured						
Green corn fodder, all analyses						
Mangels						
Rutabagas						

Feeds	Dry matter in 100 lbs.	Dig. crude protein in 100 lbs.	Total dig. nutrients in 100 lbs.	Nutritive ratio	Cost per lb. dig. crude protein	Cost of 1 lb. total dig. nutrients
Green Roughage and Silage, con.	Lbs.	Lbs.	Lbs.		Cents	Cents
Medium protein, N.R. 1:3.1 to 1:6.0						
Alfalfa, green, all analyses......	......	......	......	......	......	......
Red clover, green, all analyses......	......	......	......	......	......	......
Cowpeas, green......	......	......	......	......	......	......
Peas and oats, green......	......	......	......	......	......	......
Rape, green......	......	......	......	......	......	......
......	......	......	......	......	......	......
......	......	......	......	......	......	......
......	......	......	......	......	......	......
High protein, N.R. 1:3.0 or narrower						
......	......	......	......	......	......	......
......	......	......	......	......	......	......
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